

3. On the Amphipod Genus *Trischizostoma*.

By E. W. SEXTON.

[Received March 14, 1908.]

(Plates XIV.-XXI.*)

During the cruise of the 'Huxley' in the Bay of Biscay, August 1906, a small collection of Amphipoda was taken, which was handed to me by Dr. Allen for examination.

Amongst them was a large female specimen of *Trischizostoma niceense*. On looking into the literature of the group there appeared to be so much confusion with regard to the two genera *Guerina* and *Trischizostoma*, that a thorough revision has been necessary.

To those who so kindly assisted me in this, my best thanks are due: to Prof. G. O. Sars for his gift of a co-type of *T. raschii*; to Dott. A. Della Valle for sending me his series of preparations of *Guerina niceensis*; to the Rev. T. R. R. Stebbing for permitting me to see his (as yet unpublished) manuscript on the S. African Lysianasside, containing the description of a new species of *Trischizostoma* †; to Mons. E. Chevreux for his information concerning his specimen of *Guerinella niceensis*; to Dott. A. Brian for his paper on a specimen from the Gulf of Genoa; to Mr. W. M. Tattersall for his kindness in forwarding all his specimens to me as soon as he heard I was engaged on this paper; and to Dr. Calman for much assistance and for revising the manuscript.

I. HISTORICAL.

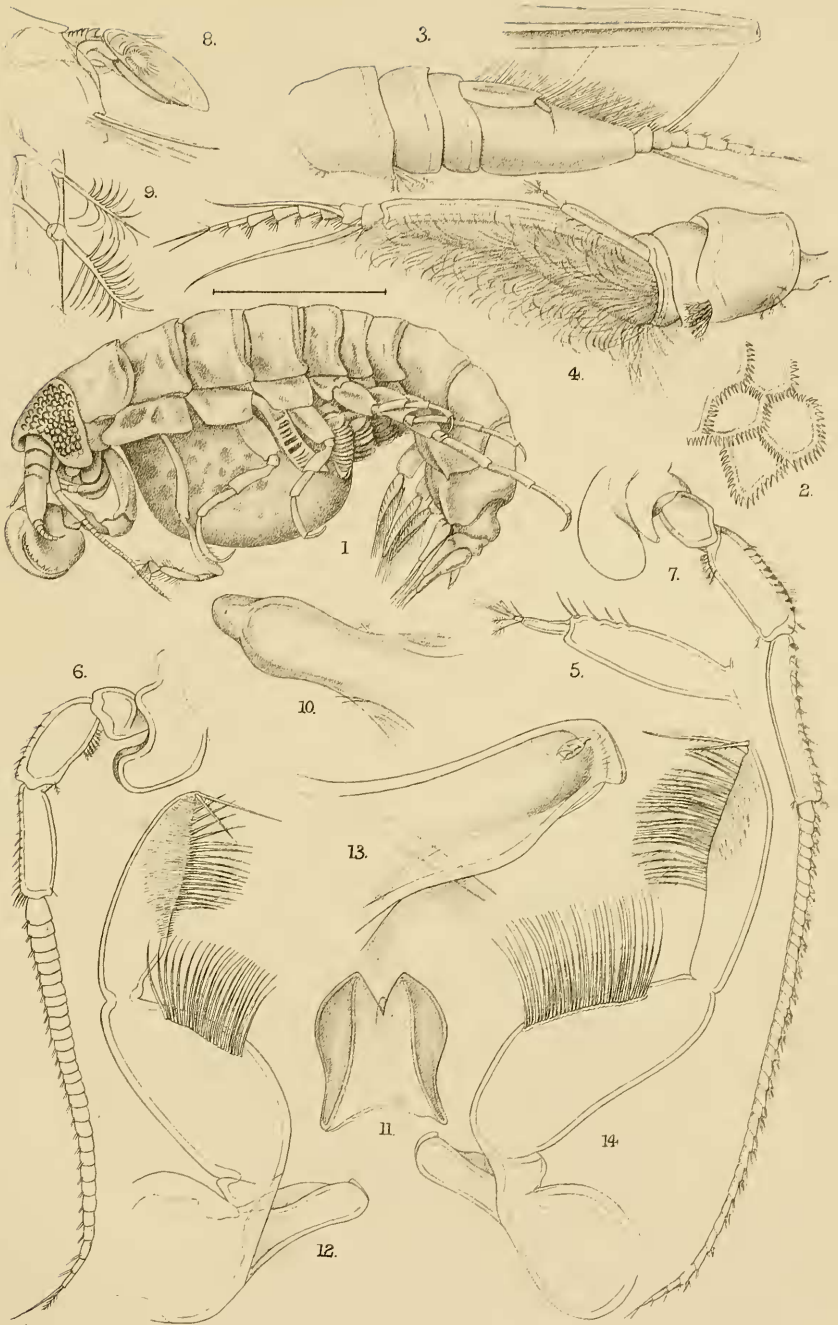
The first specimens of this genus were taken at Nice by the Rev. F. W. Hope and sent by him to the Director of the Naples Museum, Dott. Achille Costa, to be described and added to the list of Crustacea then being prepared for publication in the 'Fauna del Regno di Napoli' (2).

The description was written by Costa in 1853, a new genus *Guerinia*, Hope, being formed, and the type species, *Guerinia niceensis* figured, and was published at once with an account of two other crustaceans, under the title of "Tre nuovi Crostacei scoperti dal Rev. Gugl. F. Hope" (1). The description was published again, later in the same year, in the 'Fauna,' but the plate, although alluded to as plate vii. in the text, was omitted.

Costa recorded the specimens as parasitic on various fish, "sopra uno squalo e sul merluzzo ordinario," to which they were clinging

* For explanation of the Plates, see p. 400.

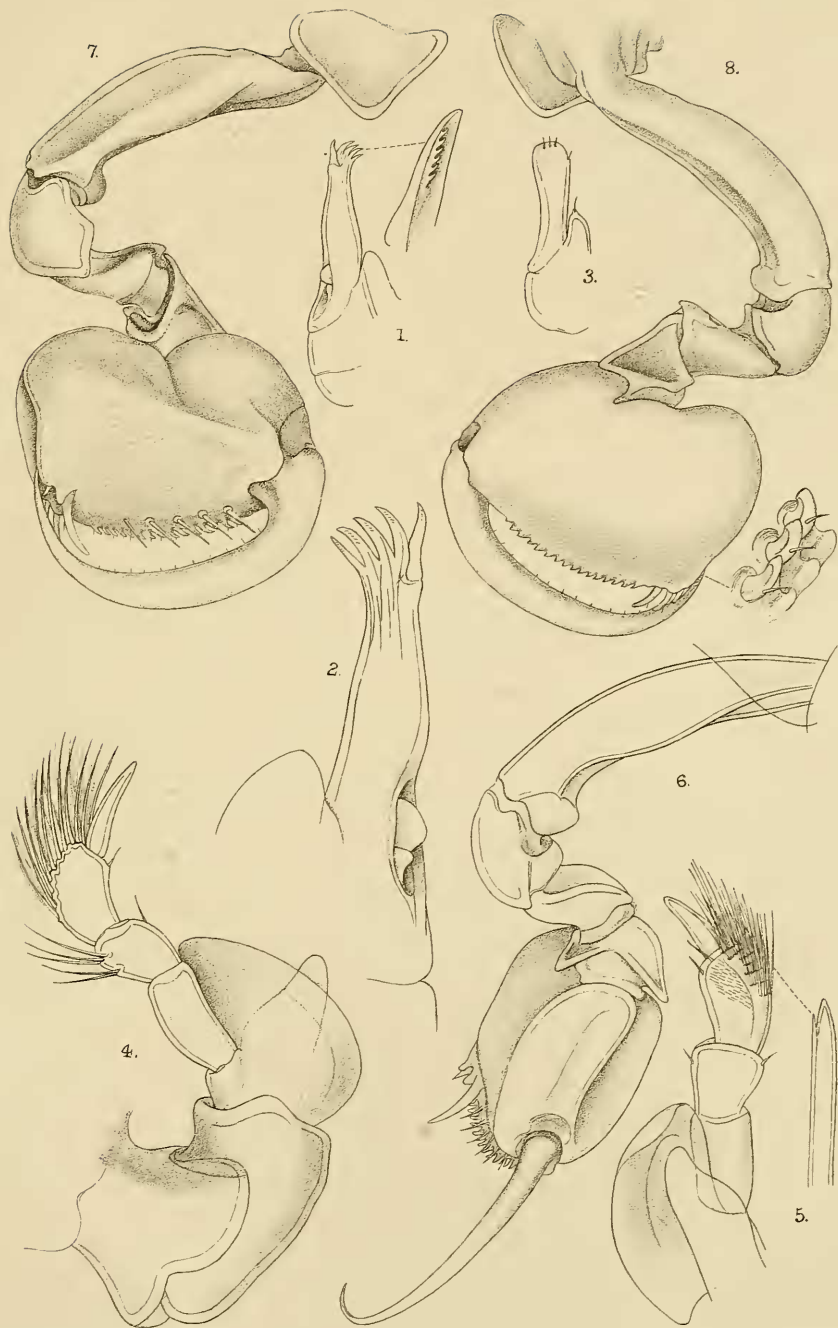
† Since this paper was sent to press, Mr. Stebbing's article, cited below (20), containing the description of this new species, *Trischizostoma remipes*, has been published in the 'Annals of the South African Museum,' vol. vi. pt. 1: South African Crustacea, pt. 4, by the Rev. T. R. R. Stebbing, M.A., F.R.S., F.L.S., F.Z.S. With 14 plates. Cape Town: April 2, 1908. Pp. 59-64, pl. xxxiv.



EW Sexton del
MP Parker lith.

Parker & West imp.

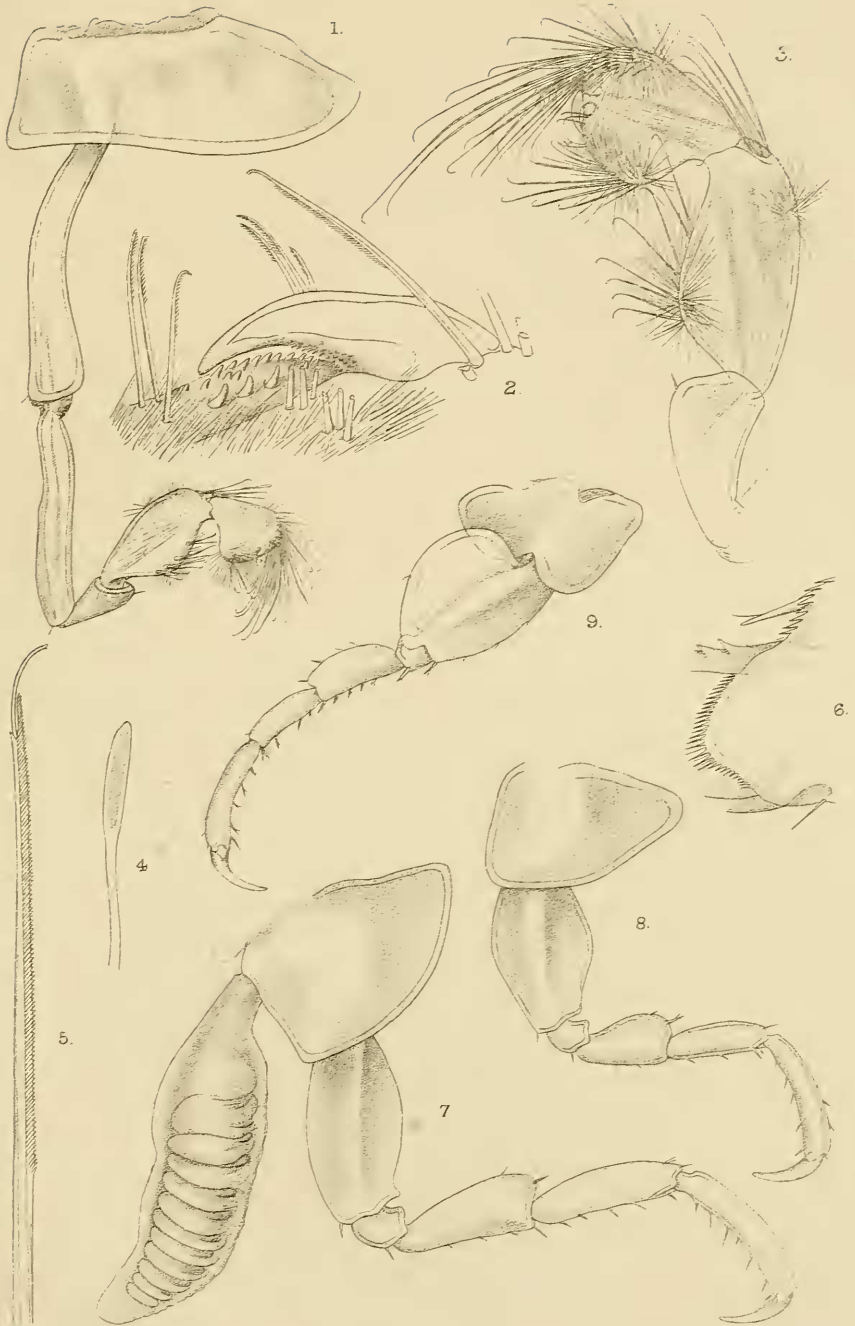
TRISCHIZOSTOMA NICAENSE, Costa.



E.W.Sexton del
M.P.Parker lith

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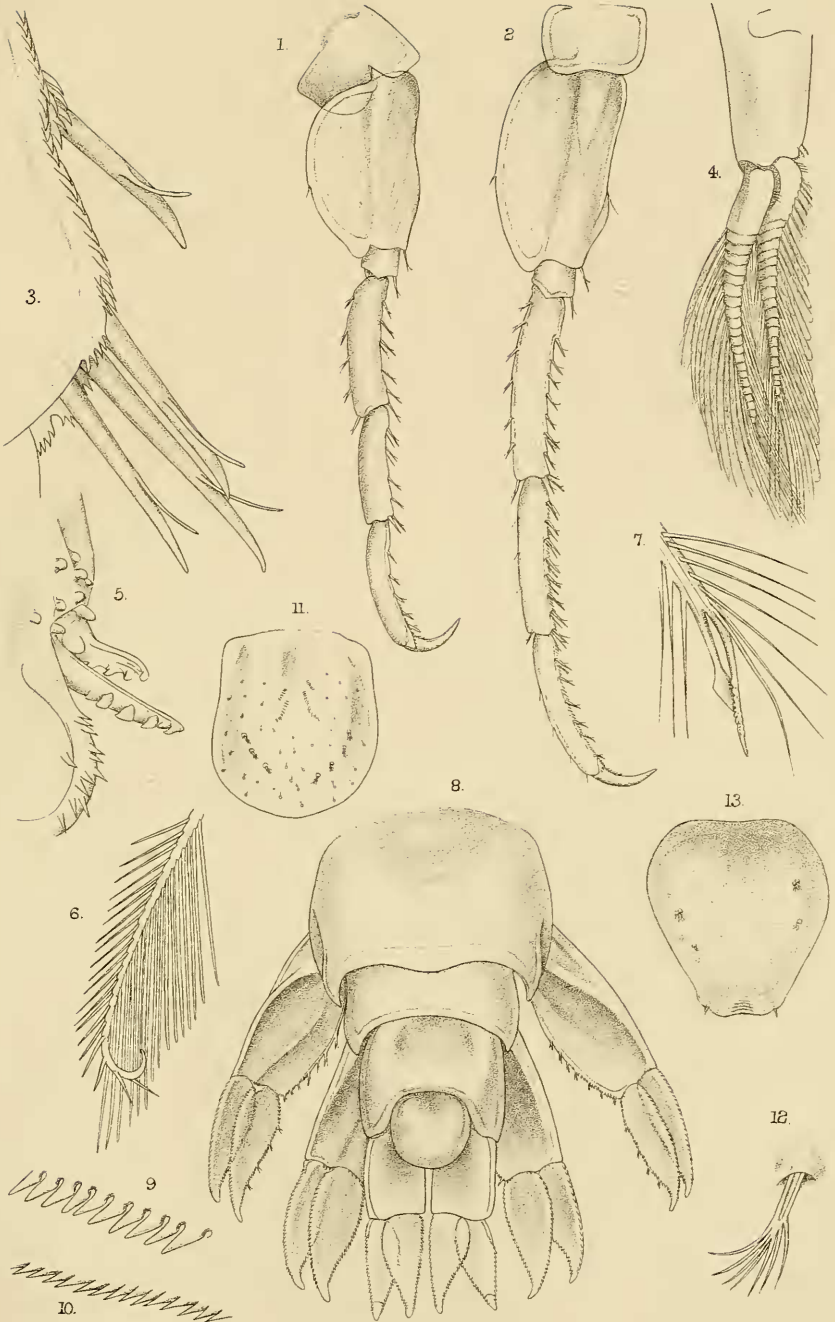
TRISCHIZOSTOMA NICÆENSE, Costa.



E.W. Sexton del.
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TRISCHIZOSTOMA NICAENSE. Costa.

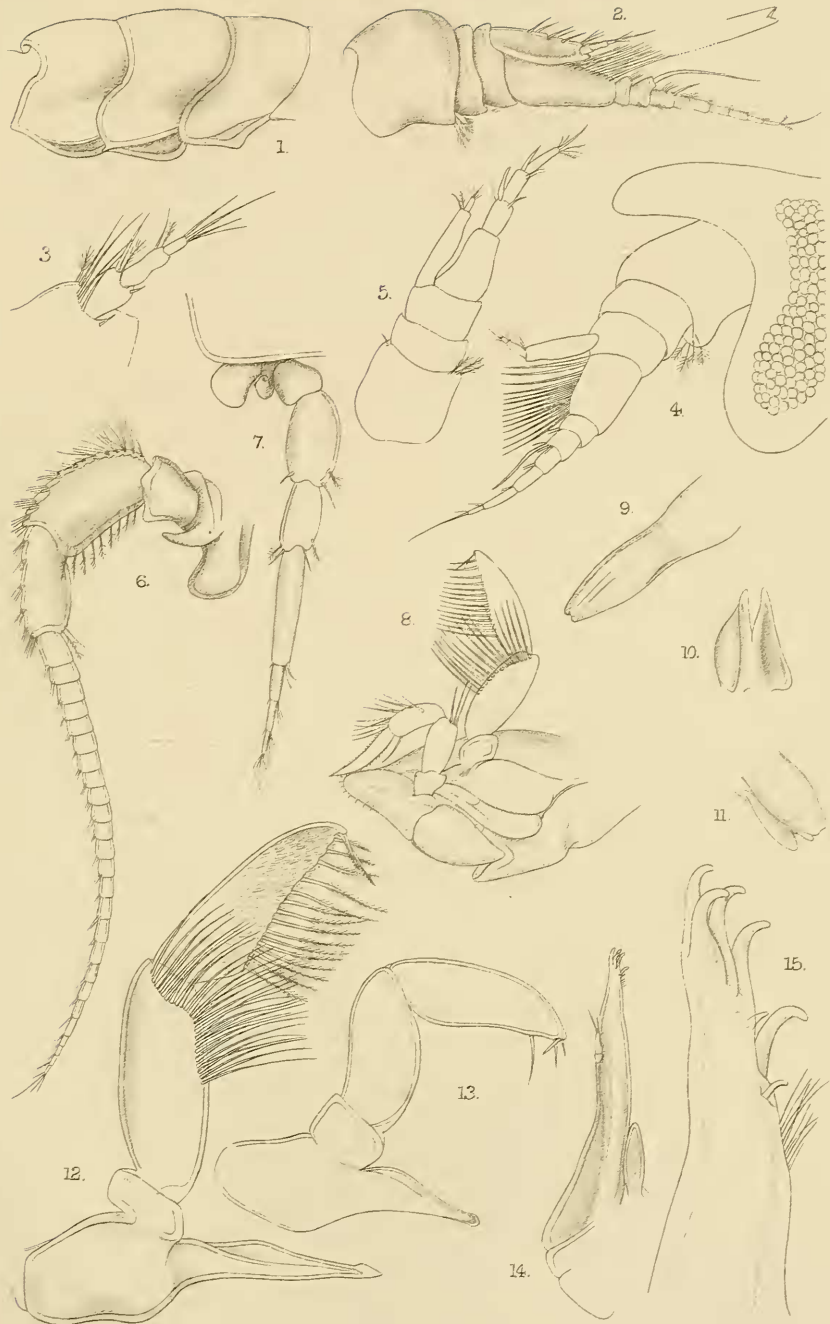


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TRISCHIZOSTOMA NICÆENSE, Costa, figs. 1-12.

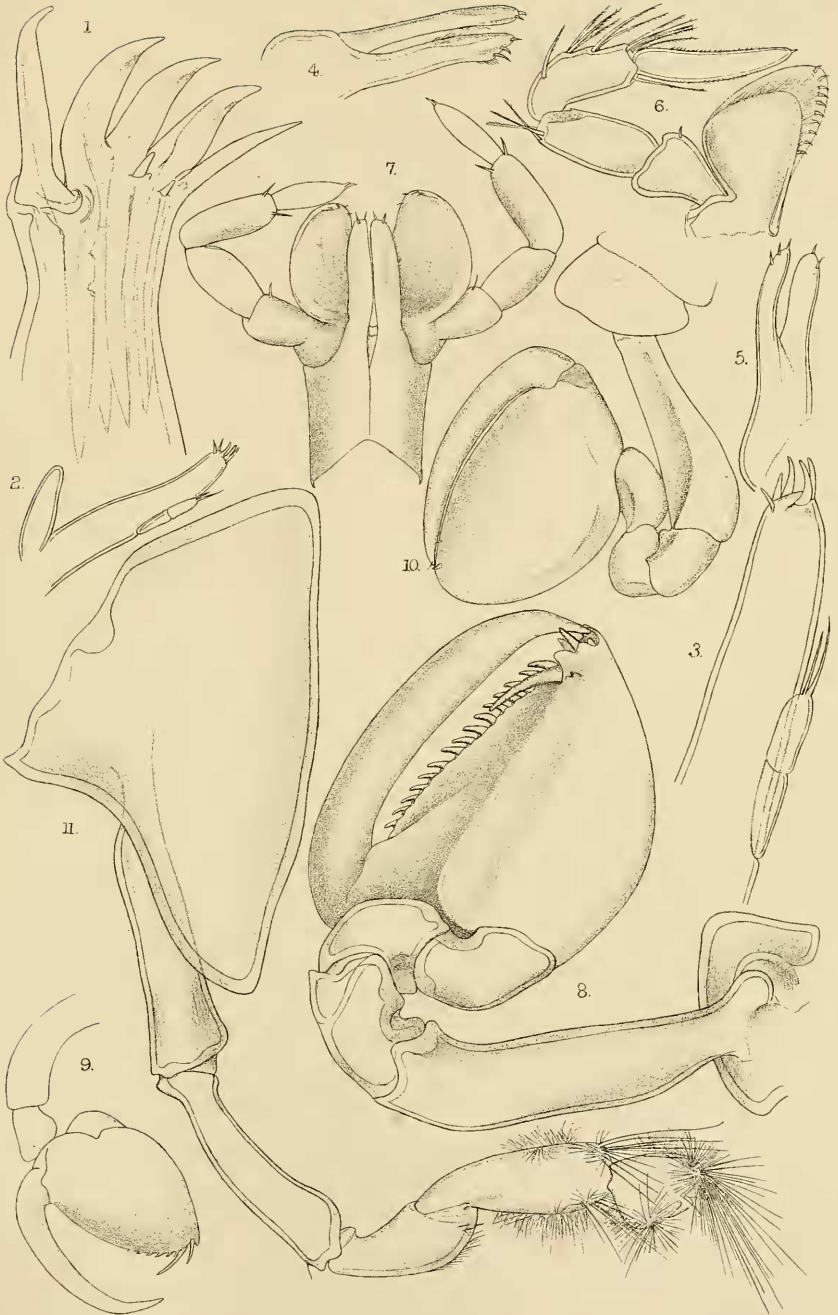
TRISCHIZOSTOMA RASCHII, Esmark & Boeck, fig. 13.



E.W. Sexton del.
M.P. Parker lith.

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TRISCHIZOSTOMA PASCHII, Esmark & Boeck.



EW Sexton del
MFParker lith

Parker & West imp.

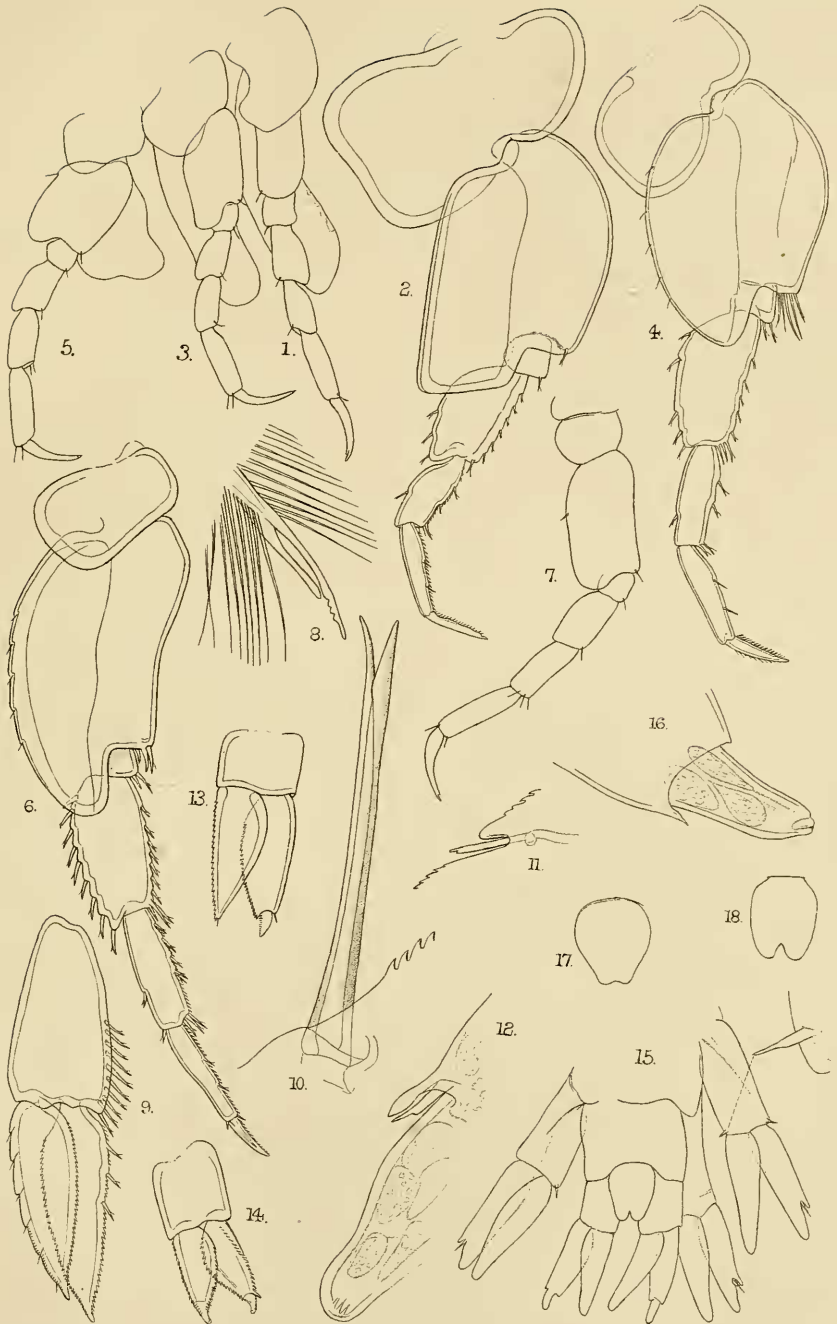
TRISCHIZOSTOMA RASCHII, Esmark & Boeck, figs. 2-11.
TRISCHIZOSTOMA NICÆENSE, Costa, fig. 1.



E.W.Sexton del.
M.P.Parker lith.

Parker & West imp.

TRISCHIZOSTOMA RASCHII, Esmark & Boeck.



EW Sexton del
MP Parker lith

Parker & West imp.

TRISCHIZOSTOMA RASCHII, Esmark & Boeck, figs. 1-13; 15-18.

TRISCHIZOSTOMA NICÆENSE, Costa, fig. 14.

by the strong claws of the first gnathopods. The figure given is that of a female, 25 mm. in length.

In 1860, Axel Boeck published his 'Observations on the Norwegian Amphipoda' (3). In this work he added a new tribe to the three already established primary divisions of the Amphipoda.

This tribe, *Prostomate*, was created for the reception of a "new and remarkable form," *Trischizostoma*, which Boeck regarded as a transition between the Hyperidæ and Gammaridæ, resembling the former in the structure of the head, the eyes, the antennæ, and the abdomen, and having much in common with the Gammaridæ, especially with the family Orchestidæ, and the genera *Opis* and *Anonyx*.

The *Prostomate* contain only the one genus *Trischizostoma* (so named by Esmark, who first distinguished it, from the trifold tube formed by its mouth organs) with the type species *T. raschii*, in describing which Boeck specially notes the peculiar structure of the first gnathopods.

The specimens described by Boeck, three large females, were dredged by Prof. Rasch at "Havbroen," a bank 20 miles off the west coast of Norway, in 100 fathoms.

In 1862, Spence Bate in his British Museum Catalogue (4) described and figured *Guerinia nicaensis*, placing the genus *Guerinia* in the subfamily *Phoxides* of the Gammaridæ, between the genera *Lafystius* and *Lepidactylis*. He adds, "For the description of this animal I am dependent upon the accuracy of the Rev. Mr. Hope's figure in the pamphlet quoted (Three New Crustacea, Fauna of Naples)"; but both the description and the figures, though evidently copied from Costa's, are inaccurate and misleading. For instance, in describing the second gnathopod, Costa states that it has one joint less than the normal number, being "entirely without a nail," and further, that "the fifth and last (article), which represents the hand, is the shortest of all, compressed, narrow at the base, dilated inferiorly, where it is fringed with stiff hairs which increase in length towards the anterior angle, the longest being twice the length of the hand"*. Spence Bate gives the normal number of joints, applying Costa's description of the hand (propodos) to the nail (dactylos) thus—"propodos very small: *dactylos* triangular, dilated, compressed, flattened at the apex, fringed with long hairs." In order to bring the figure into agreement with his description he has emphasised the line by which Costa indicated the articulation of the last joint, so making it appear as another very small joint and calling it the "propodos."

In 1865, Lilljeborg (5) published two papers on the Lysianassina, the "*Lysianassa magellanica* etc." in English, and the "Bidrag till Kännedomen" in Swedish. They contain practically the same

* "Il quinto ed ultimo (articolo) che rappresenta la mano è il più corto di tutti, compresso, stretto alla base, dilatato inferiormente, ove è ornato di peli rigidi e crescenti in lunghezza verso l'angolo anteriore, i maggiori essendo lunghi il doppio della lunghezza della mano."

matter. In the table given of the Gammaridæ, he brackets together as closely related "Subfamilia 4. *Phoxina* (Phoxides, Spence Bate), and Subfamilia 5. *Trischizostomatina* (Prostomatæ A. Boeck)"—"partes oris appendiculares non tubiformes" in *Phoxina*, and "tubiformes" in *Trischizostomatina*.

In 1867, Costa again refers to *Guerinia* in the catalogue of the Crustacea sent to the Paris Exposition (6) and gives the plate promised but not included in the 'Fauna di Napoli.'

In 1870 Boeck published his 'Crustacea Amphipoda Borealia' (7), a synopsis of the larger treatise then being prepared for the press. In this work he alters his previous classification of the group, the former tribe *Prostomatæ* being reduced to a family of the Gammaridæ. The diagnoses here given of the family *Prostomatidæ* with its one genus *Trischizostoma* and one species *T. raschii* are repeated in the later work, 'De Skandinaviske og Arktiske Amphipoder' (8), where Boeck again emphasises the resemblance to the Hyperina, and to the *Orchestidæ* and *Lysianassinæ* among the Gammarina.

Boeck records the capture of several specimens, all females, by Storm, in the Thronhjemsfjord, "parasite on a shark"—length from rostrum to telson of the largest specimens 25–30 mm.; and of "one very young one" taken by himself trawling in the Christianiafjord, at the depth of 60 fathoms.

Sars in the 'Oversigt af Norges Crustaceer,' 1882 (9), follows Boeck's classification, giving under Tribe II. *Gammarina*, Fam. I. *Trischizostomidæ*, one genus, *Trischizostoma*, one species, *T. raschii*.

In 1885, Carus in his 'Prodrömus' (10) places *Guerinia* in the subfamily *Phoxinæ* of the Gammaridæ between the genera *Lilljeborgia* Sp. Bate, and *Gammarus* (Fabr.) Sp. Bate. His description appears to be a literal translation of Spence Bate's definitions (4). He notes *G. niceensis* as peculiar to the Mediterranean fauna.

In 1886, Bovallius (11) established a new tribe *Synopidea*, intermediate between Gammaridea and Hyperidea, in which he placed the family *Trischizostomatidæ*. He gives full descriptions and figures of the adult female and a young male (5 mm. in length) of *Trischizostoma raschii*. The peculiar aspect of the first gnathopods he discovered to be due to torsion in the adult, being wholly absent in the young form.

About 20 young specimens were taken by Bovallius in July 1871 at Tjøttø, Norway, 20 miles south of the Polar Circle, in 80 fathoms; in July 1880 he found some adult females, "parasites on, or in company with, an *Asterias*" in Hardangerfjord, S.W. Norway, in 250 fathoms, the largest of these measuring 22 mm. He mentions Capt. Collin as having obtained specimens from the west coast of Novaya Zembla.

Stebbing in 1888 (12), in his introduction to the 'Challenger' Amphipoda, p. xix, writes: "A connection between the Hyperina and the Lysianassidæ has already been indicated by Boeck, who placed the family Prostomatidæ at the head of the Gammarina,

in immediate sequence to the Hyperina because of the agreement which he considered to exist between that family and the Hyperidæ and Orchestidæ. The Prostomatidæ are in close relationship with the Lysianassidæ and might, in my view, well be included in the older family." Stebbing was the first to perceive the great resemblance between the Mediterranean and Norwegian forms, and says (p. 272) of *Guerinia nicaensis*: "It is beyond doubt, generically, perhaps also specifically, identical with the later *Trischizostoma raschii* Esmark & Boeck, 1860"; and again (p. 321) of *Trischizostoma*, "the genus, at least, is assuredly a synonym of *Guerinia* Hope & Costa."

In 1890, Sars (13) demonstrated clearly that *Trischizostoma* is a true Lysianassid, basing his conclusion on the structure of the oral parts, anterior antennæ, posterior gnathopods, and the bi-articulate 3rd uropod, and pointing out that "the urosome, which Boeck considered Hyperiidæan in character, essentially differs by being divided into three distinct segments." He, therefore, places the genus in the family Lysianassidæ, giving detailed descriptions and figures of the adult female and the young form. In the summers of 1890-91 Sars obtained several specimens, all females, most of them ovigerous, in the Throndhjemsfjord, on the common black dogfish (*Spinax niger*). The largest measured 28 mm.

Bonnier in his discussion of the "Lysianassides" (14) 1892, refers to the difficulty of differentiating between the various genera, and suggests "des diagnoses courtes basées sur les véritables différences morphologiques de la structure des somites et leurs appendices, ou des clefs dichotomiques permettant d'arriver au genre et à l'espèce par l'examen d'un petit nombre de caractères, sans avoir à comparer une à une les descriptions et les figures des nombreux types qui constituent la famille des Lysianassides." He first gives the characters common to the family, and then proceeds to characterise the different genera according to the structure of the 1st maxilla, the maxilliped, the 1st pereopod, the telson and the antennule. The 1st maxilla in particular he considers useful in characterising most of the forms; for example, the four genera, *Trischizostoma*, *Acidostoma*, *Acontostoma*, and *Amaryllis* are at once distinguished from the rest by the modification of the maxillary palp. He discusses at length the conclusions of Bovallius (11) and Sars (13), agreeing however entirely with Sars.

In 1893, Della Valle (15) in his 'Sistematica' gives 10 sub-orders of the Gammarina, the tenth, Lysianassidæ, including the two genera—*Guerina* and *Trischizostoma*. On p. 770 he points out that the essential characters for distinguishing the Lysianassid genera are—the peduncle of the anterior antennæ; the mandible; and the posterior gnathopod. In the table following, *Guerina* and *Trischizostoma* (placed in close relation to *Amaryllis* and *Acidostoma*) are defined thus: "Nei gnathopodi anteriori dell'adulto l'articolazione del 3°, 4°, e 5°, articolo è tale che il margine

unguicolare della mano diventa anteriore. (La mano stessa è enormemente ingrossata); nei piedi mascellari il 1° articolo del palpo è più lungo del 2° in *Guerina*," this article being "più breve del 2°" in *Trischizostoma*.

In answer to Stebbing's words as to the "generic and probably specific identity of the two forms" he says:—"Senza dubbio fra la *Guerina* del Golfo di Napoli e il *Trischizostoma* della coste di Norvegia ognuno a prima vista nota grande rassomiglianza, sopra tutto per la forma generale del corpo, per la grandezza degli occhi e per i gnathopodi anteriori. Nondimeno, considerando meglio le varie appendici e più di ogni altra cosa le parti boccali e i piedi toracici del gruppo medio, la differenza dei due Gammarini riesce evidente non solo specificamente, ma anche genericamente." The name *Guerinia*, being preoccupied in 1830, Della Valle changes to *Guerina*. Figures are given of the male, the oral parts, gnathopods, two peraeopods, and the urosome.

The three specimens described, all males, were taken on "merluzzi"; two on November 22, 1881, off Cuma in 250 metri; and one on December 10, 1881, "al largo d'Ischia" at 150 metri. Length 12–13 mm.

In 1895, Stebbing (16) in an article contributed to 'Natural Science,' again emphasises the close relationship of the two forms, and considers the characters given by Della Valle too trivial to warrant the placing them in different genera.

In 1903, Brian (17) published a note on the capture of a *Guerinia niceensis* in the Gulf of Genoa. The specimen, an ovigerous female, 18 mm. in length, was found by Sig. Borgioli in the mouth of a *Chlorophthalmus agassizi*. The colour of the living animal he describes as "variante fra il giallo sporeo e il rosso mattone."

Chevreaux (18) in 1905 in his 'Liste des Gammarina' taken by the 'Princesse-Alice' gives: 1. *Guerinella niceensis* (Costa), and, in an explanatory footnote, his reason for changing the name; *Guerinia* and *Guerina* being so much alike as to lead to confusion, and *Guerinella* conforming to the rules of nomenclature adopted by the International Congress of Zoology.

The specimen, an ovigerous female, 19 mm. long, was taken 17/7/04 in the "filet a grande ouverture" in the Bay of Biscay, lat. 46° 15' N., long. 7° 09' W., haul from 0–3000 metres. This is the first record of this species out of the Mediterranean.

In 1906, Stebbing (19) in 'Das Tierreich' combines the two forms in one species *Trischizostoma niceense*, genus *Trischizostoma*, family Lysianassidæ, taking *T. raschii* as the female, and *Guerinia niceensis* as the male; but in a manuscript as yet unpublished (20) dated 24/7/07, which he has been kind enough to allow me to make use of, he separates them specifically, still retaining, however, the one genus and including in it a third and new species from South Africa. As he has pointed out (16) Boeck's generic name *Trischizostoma*, 1860, supersedes the *Guerinia* 1853 of Costa, preoccupied in 1830.

The South African specimens are males, 10–13 mm. in length, from Buffalo Bay—one taken in 32 fathoms S.W. by W. $\frac{3}{4}$ W., $3\frac{1}{2}$ m., and the others in 47 fathoms, lat. $33^{\circ} 9' 30''$ S., long. $28^{\circ} 3' 00''$ E.

In the following "Description of Species," the specimens described are:—

One large ovigerous female, *T. niceense*, 23 mm. long, taken by Dr. Allen, 26.viii.06, on the 'Huxley' in the Bay of Biscay, in 246 fathoms; lat. $48^{\circ} 7'$ N., long. $8^{\circ} 13'$ W.; Agassiz trawl. Free-swimming.

And seven specimens taken by Mr. W. M. Tattersall on the 'Helga,' as follows:—

7.viii.1904. Four specimens, *T. niceense*: three females, respectively 20, 20.5, and 22 mm. long, and one male, 21.5 mm., the first male recorded out of the Mediterranean. 50 miles W.N.W. of Tearaght, Co. Kerry, Ireland, 396 fathoms. Net at 237 fathoms. Free-swimming.

5.xi.1905. One specimen, *T. niceense*, a male, 20 mm. long, 50 miles W. $\frac{3}{4}$ N. of Tearaght, Co. Kerry, Ireland, 411 fathoms. Net at 75 fathoms. Free-swimming.

February 1906. One specimen, *T. niceense*, a male, 21.5 mm. Lat. $51^{\circ} 54'$ N., long. $11^{\circ} 54'$ W., 460 fathoms. Net at 350 fathoms. Free-swimming.

August 1906. One specimen, *T. raschii*, immature female, 9 mm. Lat. $50^{\circ} 37'$ N., long. $11^{\circ} 12'$ W., 250–542 fathoms. Taken in a small net attached to the trawl. This is the first record of this species out of Norwegian waters.

II. DESCRIPTION OF SPECIES.

Only three species of this genus are known so far: *T. niceense*, recorded from Naples, Genoa, Nice, the Bay of Biscay, and the west coast of Ireland, of which the male and female have both been taken; *T. raschii*, ranging from the Arctic Circle to Christianiafjord, Norway, and from the west coast of Ireland, only the female and young of this species are known; and Mr. Stebbing's new South African species, of which the male only has been captured.

Detailed descriptions and figures of the first two species are given here to prove the justice of their inclusion in the same genus.

1. TRISCHIZOSTOMA NICEENSE (Costa). (Plates XIV., XV., XVI., XVII. figs. 1–12, Pl. XIX. fig. 1, and Pl. XXI. fig. 14.)

Syn. 1853. *Guerinia niceensis* Hope in litt., Costa (1).

1893. *Guerinia niceensis* Della Valle (15).

1905. *Guerinella niceensis* Chevreux (18).

1906. *Trischizostoma niceense*, ♂, Stebbing (19).

Both the male and the female of this species are known. The male has been figured by Della Valle, but no accurate figure of

the female has been published hitherto. The figure given by Costa is evidently that of a female, but his specimens cannot be traced. The last mention of them is in the 'Annuario' (6), where they are referred to as forming part of the Collection of Crustacea sent to the Paris Exposition, 1867. The method of preservation is described, the specimens being dried and mounted in glass cells.

Though the geographical range of this species is wide, the specimens taken have been few in number: Costa's specimens; the three males described in Prof. Della Valle's work (15); a female from the Gulf of Genoa; two females from the Bay of Biscay, one taken by the 'Princesse-Alice,' and one by the 'Huxley'; and Mr. Tattersall's six specimens, all from the west coast of Ireland, three females and three males. Thanks to Mr. Tattersall's kindness in permitting me to examine these last and to dissect a male specimen, I have been able to satisfy myself that the oral parts taken by Della Valle as characters to differentiate the genera *Guerina* and *Trischizostoma* are really identical in structure in both forms. The first maxilla, in particular, which he describes as lacking the inner plate, and with the palp reduced to a small and simple tubercle, will be seen to possess not only the inner plate, but a minute, distinctly bi-articulate palp (Pl. XV. figs. 1 & 2). These structures, however, are so exceedingly fragile and pellucid as to render dissection very difficult. The little leaf-like palp arises in a small hollow inside the margin of the outer plate, and sets out at right angles to it; when mounted for the microscope the weight of the cover-glass is quite sufficient to depress it into the hollow, thus giving the effect of a little tubercle.

The description of the male is taken principally from the Irish specimen, 21.5 mm. in length; that of the female from the 'Huxley' specimen, 23 mm. in length. All the measurements are taken in the same way, from the tip of the rostrum to the tip of the telson, along the medio-dorsal line.

There is little difference between the sexes, the principal distinguishing characters being found in the antennæ.

The *Integument* is very characteristic, having the appearance of "pitting"; under a high power each little pit is seen to be irregularly six-sided and fringed with sharp spines (Pl. XIV. fig. 2).

The *Head* is much deeper than the pereon, about as long as deep; rostrum broad, apically rounded, curving right over the bases of the superior antennæ. The head is longer than the first segment of the pereon (2.5 mm. to 1.5 mm.), about as long as the first segment and half the second. *Eyes* large, dark brown in colour, the pigmented masses on each side numbering not less than 60 ommatidia, arranged in eight or nine transverse rows, with an irregular row of smaller unpigmented ommatidia entirely surrounding the pigmented masses and meeting in the medio-dorsal line.

PEREON.—The 1st segment is the longest; the 2nd, 3rd, and

4th are shorter and subequal; the 5th is smaller again; and the 6th and 7th are the shortest of all and subequal. All, except the first, are produced at the posterior angles and rounded.

Side-plates.—About half as deep as the body (see peræopod figs. for the correct proportions. They are not well represented in the figure of the whole animal owing to the immense distension of the ovisac forcing them out of the normal position). The 1st is small, triangular, almost entirely covered by the large 2nd. This side-plate is the largest of all, greatly dilated inferiorly and produced forward, posterior margin straight. The 3rd is almost as deep as long, with the anterior distal angle produced forward, posterior margin straight, inferior margin rounded; the 4th is similar, but smaller; the 5th and 6th successively smaller, inferiorly bilobed; the 7th is the smallest, subquadrate.

PLEON.—First three pleon segments subequal, large, equalling the first pereopod segment in length. Epimeral plates large and rounded, the 2nd and 3rd with a lateral carina which in the 2nd terminates in a denticle at the postero-lateral angle. The 4th segment is deeply depressed dorsally; the 5th is shorter than the 4th or 6th; the 6th is depressed dorsally and emarginate for the insertion of the telson.

SUPERIOR ANTENNA.—*Female* (Pl. XIV. fig. 3). The first joint of the peduncle is as long as the two following taken together, broader than long, with a fringe of about 24 of the so-called "auditory setæ" around the distal posterior angle, and 8 smaller similar setæ in a cluster on the proximal posterior margin.

The *primary flagellum* consists of one long broad joint and eight small. The 1st joint nearly equals the peduncle in length and is as long as the eight small joints taken together. It carries on its inner surface two longitudinal bands of laminar hyaline filaments (see fig.), about 38 transverse rows in each band. The 2nd joint widens distally and is furnished at the inner posterior angle with a long, rigid, slightly curved spine reaching to the tip of the flagellum; the 3rd has a similar but shorter spine inserted at the outer anterior angle. The 2nd, 3rd, 4th, 5th, and 6th joints are all fringed on the inner margin with a row of small, stiff, curved setæ, deeply inset; the apical joint is tipped with two long stiff setæ.

The *accessory flagellum* is inserted anteriorly in a deep emargination of the peduncle and is composed of one long laminar joint and two small ones.

The number and proportions of the joints appear to vary with the age of the specimen. The 'Huxley' specimen, just described, and one of the Irish specimens, 20.5 mm. in length, have each nine joints in the primary flagellum, with the first joint cylindrical and swollen. The other two Irish specimens, 20 mm. and 22 mm. respectively, have eight joints, the first joint much more slender, and incurved like that of the male, and the accessory flagellum much longer in proportion. These two females appear to be younger than the others—the claws and spines are much less worn.

Male (Pl. XIV. figs. 4 & 5).—This antenna is much longer in the male than in the female, measuring 5 mm. in a specimen 21.5 mm. in length, as compared with 3 mm. in a female specimen of 23 mm.

The *peduncle* is not so long as in the female. First joint nearly twice as long as the 2nd and 3rd taken together (measured along the inner surface) with the “auditory setæ” as in female.

The *primary flagellum* consists of nine joints. The 1st is half as long again as the others taken together; it is incurved and covered on its inner surface with dense masses of the long sensory filaments. The six following joints are narrow proximally, widening distally, and carrying on their inner margins fringes of the small, stiff, curved setæ, the 2nd and 3rd having the long rigid, outstanding spines as in female, and the 5th, 6th, and 7th each with a calceolus. The 8th and 9th are slender and cylindrical, the 9th tipped with one long stiff bristle, one long seta and one small one.

The *accessory flagellum* is much smaller than in the female, not reaching to half the length of the first joint of the primary. It is composed of one long laminar joint, one small joint slightly constricted in the middle, and a minute apical joint. The 1st joint has four small setæ inset on the distal margin; the 2nd one “auditory” and one simple seta; and the terminal joint has two of the “auditory” and two or three simple setæ.

INFERIOR ANTENNA.—*Female* (Pl. XIV. fig. 6). The 1st joint of the peduncle is produced posteriorly downwards in a thick laminar lobe; it is hollowed behind, and in this hollow lies the small 2nd joint with its large antennal cone; the 3rd joint is small, as wide as long; the 4th is more than twice the length of the 3rd; the 5th is not as broad as the 4th and very slightly longer.

Setæ.—The first three joints carry no setæ. The 4th is furnished on the posterior margin with seven long auditory setæ proximally and one at the distal angle; with eight tufts of small setæ on the anterior margin. The 5th has twelve of these tufts along the anterior margin, and a fringe around the anterior angle; with one small seta at the posterior angle.

The *flagellum* consists of 29 joints, the first the largest; 26 of these are short, wider than long, decreasing gradually in size, each with a row of setæ inset anteriorly above the distal angle; the three terminal joints are very slender, cylindrical, the apical joint having one long stiff bristle and one auditory seta.

In the Irish specimens the proportions of the joints of the peduncle are the same as described above; the number of joints in the flagella vary—the 20.5 mm. specimen having 27; the 20 mm. having 20; and the 3rd specimen of 22 mm. with 22.

Male (Pl. XIV. figs. 7, 8, 9). The first two joints of the *peduncle* as in female; the 3rd a little longer; the 4th twice the length of the 3rd; the 5th as long as the 3rd and 4th taken together, more slender than the 4th, narrow proximally, slightly curved, with the anterior margin concave.

Setae.—The first three joints are without setæ. The 4th has twelve auditory setæ on the posterior margin (fig. 9), eleven proximally and one at the distal angle; anteriorly it is provided with nine groups or rows of small setæ set transversely on the margin, with one auditory and one small seta at the distal angle. The 5th joint has one auditory seta at the posterior distal angle; and, on the anterior margin, eleven of the small transverse rows of setæ, with a fringe of setæ and one auditory seta at the distal angle.

The *flagellum* is half as long again as the peduncle, filiform, much more slender than that of the female. It consists of 38 small joints; the first with the posterior margin shorter than the anterior, and the others with the anterior angle a little produced downwards, giving an oblique look to the articulations. The first 25, subequal in length, gradually decrease in width, the following joints being longer and narrower. Each joint bears anteriorly a little bunch of setæ at the distal angle. There is a calceolus on each of the first three joints, then one on alternate joints to the 35th, the calceolus (fig. 8) being set on a little protuberance above the bunch of setæ. The first joint also bears a large "Reichzapfen." The three terminal joints are exceedingly slender, the apical one tipped with two setæ.

In the second specimen, 21.5 mm. long, the flagellum is twice the length of the peduncle and consists of 40 joints, the terminal four very minute and without calceoli. The first four have each a calceolus, after which they occur on alternate joints to the 36th. The third specimen, 20 mm. in length, has lost the tips of both antennæ; 33 joints still remaining on each.

ORAL PARTS.—*Upper and Lower Lips* (Pl. XIV. figs. 10 & 11). The upper lip is elongate, deeply hollowed, apex entire and produced forward. The lower lip is divided at the tip into two lobes, with a minute pellucid structure between the apices.

MANDIBLE.—*Female* (Pl. XIV. figs. 12 & 13). The large basal portion carrying the palp is produced forwards in a laminar process, with truncate cutting-edge, feebly spatulate, no molar. On the inner surface distally are three spinules.

The 1st joint of the *palp* is very small; the 2nd large, about six times as long as the 1st, broad, rounded anteriorly, carrying along the distal half of the anterior surface inside the margin a row of 25 long, curved bristles, with plain shafts and minutely serrate tips. The 3rd joint is lanceolate, as long as the 2nd, but only half the width, with 17 long bristles on the anterior margin of the right mandible, 18 on the left mandible. These bristles are plumose for half their length and curved, the distal three being more widely spaced, smaller and more curved than the others. At the apex of the joint, set at a different angle from the others and from each other, are two bristles, the apical one half the length of the other, which is the longest on the palp; the shafts are dentate on either side, and the tips are long, stiff and finely plumose. The greater part of the joint is thickly covered with fine transparent flat spines.

Male (Pl. XIV. fig. 14). The apex of the front part of the trunk is more spatulate than that of the female. The proportions of the joints of the *palp* vary a little also, the 3rd joint being slightly longer than the 2nd, which is more elongate in form than that of the female. The row of bristles on the 2nd joint commences lower down the margin; in the right mandible they number 34 on the 2nd joint, and 27 on the 3rd; the left mandible having 31 on the 2nd, and 26 on the 3rd. The numbers appear very variable. In the Mediterranean specimen examined they were: right mandible 37 and 26 respectively; and on the left 30 and 25.

FIRST MAXILLA (Pl. XV. figs. 1 & 2).—The *outer plate* is elongate, with five strong claws apically, four much curved, and serrated (see fig. 1, detail). The plate is contracted below the apex and again at the insertion of the palp. The small pellucid *inner plate* is of very delicate structure, unarmed. The *palp* is bi-articulate, minute, set in a hollow and united along its length to the inner surface of this hollow, the laminar leaf-like second joint being twice the length and breadth of the first.

There is practically no difference between the sexes, except that the first maxilla of the male is longer than that of the female and the apical claws are longer.

SECOND MAXILLA (Pl. XV. fig. 3).—Slightly larger in male than in female. *Inner plate* small, tipped with one setule; *outer plate* broad and rounded distally, hollowed underneath, with three setules on the apical margin and one on the inner side.

MAXILLIPEDS (Pl. XV. figs. 4 & 5).—*Female*. The basal joints deeply curved; the 2nd joint of the one maxilliped fused with that of the other for nearly three quarters of its length. *Inner plates* fairly large, narrowing apically, unarmed. *Outer plates* extending beyond the distal margin of the first joint of the palp; large, unarmed except for one or two microscopic setules.

The 1st joint of the *palp* is large and broad; the 2nd short, widening a little distally, with one seta at each angle; the 3rd is the largest of all (measured along the outer margin), lightly curved, with seven transverse rows of strong bristles on its under surface (see detail, fig. 5), and two setæ on the inner distal margin. Distally the under surface of the joint is covered with a spinose armature similar to that of the mandibular palp. The 4th joint is subequal in length to the 2nd, narrow and unarmed.

Male. The basal portion and plates are the same as in the female, but the proportions of the joints of the palp vary.

The 1st joint is the longest; the 2nd the shortest, with one seta on its inner angle and two clusters of the long bristles distally on the outer margin; the 3rd joint is slightly shorter than the 1st, curved, densely setose on its under surface, with about ten transverse rows of long bristles; the 4th joint is subequal to it in length, but only half its width and unarmed.

FIRST GNATHOPOD (Pl. XV. figs. 6, 7, & 8) very powerful, with the chitinous margins of extraordinary thickness, and longi-

tudinal ridges of chitin on all the free joints. The 2nd joint is very long and curved; the 3rd, 4th, and 5th are subequal, the 3rd and 4th continuing the curve of the 2nd; the 5th with a longitudinal ridge produced to a point on each side of the articulation with the 6th (see fig. 6). The 6th or "hand" is usually carried as in fig. 6, immensely swollen, with the inner side (fig. 8) rounded and more swollen than the outer (fig. 7). The palm margin is bordered with strong, incurved, mobile teeth, 15 in number, each with a tubercle behind (see fig. 8, detail), and with five long, slender, mobile spines above the margin. The hand has the deep groove or channelling described by Costa, "una scanalatura nella faccia esterna," into which the acuminate tip of the long claw fits. At the prehensile angle, on the outer edge of this groove is a very long, mobile, curved spine, with a small one beside it, each with a tubercle posteriorly, while on the under edge are two medium-size spines, one larger than the other; all four spines are provided with small flagella. The powerful curved claw or "finger" is very long, longer than the palm margin, with 12 or 13 minute sensory setules along its inner surface.

The only difference between the sexes is—in the male the hand, while equally broad, is slightly longer than that of the female, and the palm margin is provided with more spines.

Females. In the 'Huxley' specimen, 23 mm., the width of the hand is 2.5 mm., with 5 long spines and 15 small teeth on the palm margin; hand figured (fig. 7). Of the Irish specimens, the first 20.5 mm. long measures 3 mm. across the hand, with 5 long and 16 small teeth, hand as fig. 6; in the second specimen, 20 mm., the hand measures 3 mm., 5 long and 18 small teeth, hand inverted; in the third female, 22 mm., the hand measures 2.75 mm., 5 long and 18 small teeth, hand as fig. 7.

Males. In the specimen figured, 21.5 mm. in length, the hand measures 3 mm., 6 long and 19 small teeth (fig. 6). The second specimen, 21.5 mm., is exactly similar; the third of 20 mm. length measures barely 3 mm. across the hand, 6 long and 18 small teeth, hand carried as in fig. 6.

SECOND GNATHOPOD (Pl. XVI. figs. 1, 2, 3, 4, & 5).—The 2nd joint is very long and slender, curved, widening distally; the 3rd is rather more than two thirds the length of the 1st, longer than the two following taken together, laminar, the distal half of the joint wider than the proximal; the 4th joint is small, narrow proximally, twice as wide at the distal end, rounded posteriorly, with the posterior margin twice the length of the anterior; the 5th is longer than the 4th, ovate elongate, narrow at both extremities, considerably expanded posteriorly; the 6th bends backward towards the 5th, almost discoidal in shape, as wide as long, very narrow proximally, but expanding both anteriorly and posteriorly. The 7th joint or claw is very minute, set transversely in the middle of the distal margin of the 6th, so that the point of the claw impinges against the under surface of the margin. It is completely concealed by the dense masses of setæ, which is,

no doubt, the reason why it escaped detection by Costa (2) ("privo affatto di unghia").

Setæ.—The 2nd, 3rd, and 4th joints each carry a seta at the posterior distal angle; the 5th is covered on the anterior and posterior surfaces with dense masses of delicate, hyaline, sensory hairs (fig. 4), with a fringe of long jointed setæ at the anterior angle, and four clusters of the same along the posterior margin (for detail see fig. 5). The 6th joint is thickly covered with the hyaline hairs, with a large number of the jointed setæ anteriorly, increasing in length to the anterior angle, the longest being twice the length of the joint; the posterior angle also bears a cluster of shorter, jointed setæ. These "hyaline hairs" and "jointed setæ" are peculiar to the 5th and 6th joints; the 6th joint having yet another kind, stiff, curved, and serrate, similar to that figured for *T. raschii* (Pl. XX. fig. 3). A cluster of about four to six of these is to be found on each side of the claw, and three just beyond its tip. The claw itself is denticulated on its inner surface, and the portion of the margin against which it impinges is thickly dentate (fig. 2).

PERÆOPODA.—Branchial vesicles occur on all the peræopoda, long and much pleated on the first and second, shorter and more divided on the three posterior pairs. Incubatory lamellæ are attached to the first three, as well as to the second gnathopod. The sixth joint of each peræopod is produced over the base of the claw in two delicate transparent plates, or "dactyloptera" (see Spence Bate, 4, p. 317), with pectinate margins (Pl. XVI. fig. 6). The tactile spines of the peræopoda and uropoda are of similar construction. Each consists of a stout shaft, blunt-tipped, carrying subapically a slender flagellum (cf. Pl. XVII. fig. 3).

FIRST PERÆOPOD.—*Female* (Pl. XVI. fig. 7). 2nd joint long, a little longer than the two following taken together, expanded, rather narrowed proximally; 3rd very small; 4th long, a little dilated anteriorly, 5th subequal to the 4th in length; 6th longer than the 5th, narrow; the 7th or claw moderately curved, about half the length of the 6th.

Setæ.—The 2nd and 3rd joints each carry one seta at the posterior angle. The 4th has, anteriorly, one small seta and one large spine at the distal angle, with three setæ along the posterior margin and one at the angle. The 5th has two setæ at the anterior angle; one at the posterior, and four along the margin. The 6th has one small seta at the anterior angle; the posterior margin is dentate, with seven strong setæ inserted at intervals along it. The claw is provided with eight denticles on the proximal half of the inner margin.

Male. 2nd and 3rd joints as in the female; 4th and 5th slightly longer, the 6th and 7th distinctly longer, than in the female.

Setæ.—The posterior margins of the 4th and 5th have each one seta more, and the 6th two setæ more, than the female; the posterior margins of both the 5th and the 6th are dentate; the claw with ten denticles.

SECOND PERÆOPOD.—*Female* (Pl. XVI. fig. 8). Very similar to the first peræopod, but with the 2nd, 3rd, 4th, and 5th joints shorter; the claw is equally as long; the 2nd joint a little more expanded than in the first peræopod; the setæ on the joints much less in number; claw without denticles.

Male. 2nd, 3rd, 4th, and 5th joints as in the female; 6th and 7th longer.

Setæ as in the female.

The THIRD PERÆOPOD is the shortest of all.

Female (Pl. XVI. fig. 9). The 2nd joint long, broadly oval, anteriorly rounded, posterior margin laminae expanded and produced a little downwards, widest proximally. The 3rd small; the 4th and 5th practically subequal, the 4th a little dilated posteriorly. The 6th is nearly as long as the 2nd, narrow. Claw moderately curved, nearly two thirds the length of the 6th.

Setæ.—The 2nd joint has one minute sensory setule indented in the middle of the posterior margin and three in the anterior margin, with one large spine at the anterior angle. The 3rd carries one spine on the anterior angle. The 4th has one spine and two or three of the sensory setules posteriorly; with four spines on the anterior margin and two at the distal angle. The 5th has three on the anterior margin and two at the angle. The 6th is provided posteriorly with three minute setules and anteriorly with five spines. The claw is apparently without denticles.

The branchial vesicle extends to the distal margin of the 5th joint.

Male. The 2nd joint is as long as the 2nd and 3rd taken together in the female, with the anterior margin lightly concave; the following joints a little longer, the 6th decidedly so.

Setæ.—As in the female, except that the 6th is furnished with a few scale-like spines on the anterior distal angle, and the claw bears four denticles.

FOURTH PERÆOPOD.—*Female* (Pl. XVI. fig. 6, Pl. XVII. fig. 1). 2nd joint long, lightly concave anteriorly, laminae expanded posteriorly, and a little produced downwards; the 3rd small; the 4th and 6th subequal to each other in length; the 5th shorter than the 4th or 6th; 7th half the length of the 6th.

Setæ.—The 2nd joint has one minute sensory setule inserted midway on the posterior margin and one spine at the anterior angle. The 3rd carries one at the anterior angle. The 4th has four on the margin, and one large one at the angle posteriorly; with four at the anterior angle and six on the margin, two of these being inserted in the same indentation, one a little behind and below the other, an arrangement characteristic of the hinder peræopoda. The 5th carries two of these pairs and two single spines on the anterior margin, and three large spines on the angle, which is produced underneath in a pectinate fringe (*cf.* Pl. XVII. fig. 3). The 6th bears five spines on the anterior margin, the distal half of which is dentate. The claw is provided with two denticles.

Male. The proportions of the joints to each other are the same as in the female, but all are longer, the 2nd, for example, equalling the 2nd and 3rd of the female taken together.

Setae practically the same as in the female. The 5th has three pairs and two single spines; the 6th one pair and five single, with the distal half of the margin dentate; the claw has four denticles.

FIFTH PERÆPOD.—*Female* (Pl. XVII. figs. 2 & 3). 2nd joint long, a little concave anteriorly with an oblique groove midway along the margin in which the branchial vesicle rests, less expanded posteriorly than the preceding peræpod; 3rd small; 4th as long as the 2nd and longer and broader than the 5th or 6th; 5th and 6th subequal; 7th half the length of the 6th.

Setae.—This peræpod is armed anteriorly with a formidable array of spines. The 2nd joint has the one minute setule posteriorly; one large spine on the anterior angle. The 3rd has one large spine. The 4th carries six on the margin and one at the angle posteriorly; one pair and six single on the margin and three at the angle anteriorly. The 5th has three of the sensory setules and one spine posteriorly; the anterior margin dentate with six pairs and one single spine inset and three at the angle (fig. 3). The anterior margin of the 6th is also dentate with one pair and five single spines inset; four sensory setules posteriorly. The claw is provided with five denticles (seven in another specimen).

Male. Proportions of the joints to each other as in the female, but all longer.

Setae.—Nine spines on the anterior margin of the 4th joint; three pairs and four single spines on the 6th, the rest as in the female; five denticles on the claw (three on the Mediterranean specimen).

PLEOPODS (Pl. XVII. figs. 4, 5, 6, 7).—The peduncles are large and stout, with two little coupling spines (fig. 5). The rami are about twice the length of the peduncles. The *outer ramus* has 22 articulations, the long first joint carrying on both margins proximally a tuft of fine hyaline sensory hairs with flattened tips; the inner ramus is provided with similar tufts and has six cleft spines (fig. 7) on the inner side of the first joint, with an uncinata plumose seta (fig. 6) on each of the following thirteen joints on the inner side.

UROPODS (Pl. XVII. figs. 8, 9, 10).—The peduncles are large and stout; that of the 1st uropod longer than the rami; that of the 2nd subequal to the rami in length; while in the 3rd the rami are slightly longer than the peduncle. The apices of the 1st uropods reach considerably beyond the peduncles of the 3rd; those of the 2nd and 3rd are almost on a level (fig. 8). The rami of the 1st and 2nd pairs are greatly curved.

The *first uropod* has seven small spines on the inner margin of the peduncle which is serrated for half its length, with small serrations along the distal margin also. The outer ramus

is shorter than the inner, with the outer margin armed with scale-like spines and the inner with strong teeth (fig. 10). The inner ramus has the margins serrated (fig. 9), the under margin beset with two spines in the female and four in the male.

In the *second uropod* also, the outer ramus is shorter than the inner. The peduncle is serrated along the distal margin and around the inner angle, with two spines on the angle. The rami as in the first uropod but without spines. The outer ramus of the *third uropod* is bi-articulate, with a spinule inserted at the outer distal angle of the first joint; all the margins serrate.

TELSON (Pl. XVII. figs. 11 & 12) as broad as long, margin entire. It carries four oblique rows of microscopic spinules, two on each side of the medio-dorsal line, the distal rows longer than the proximal. It is also provided with two rows of tufted setules, four on one side and three on the other (fig. 12), each set in a little pocket (cf. *T. raschii*, fig. 13). These tufted setules are peculiar to the telson.

The principal *points of difference* between this species and the following, are:—The shape of the rostrum, curved in *T. niceense*, horizontal in *T. raschii*; the size and number of the ommatidia; the shape of the 2nd, 3rd, and 4th side-plates; the 2nd maxilla, the inner lobe small in *T. niceense*, subequal to the outer in *T. raschii*; the maxilliped palp, the first joint long, the second short in *T. niceense*, the reverse in *T. raschii*; the shape of the hand of the first gnathopod; the 1st and 2nd peræopods, the 2nd joint being dilated in *T. niceense*, the 4th in *T. raschii*; the shape of the 2nd joint of the 3rd peræopods; and lastly the shape of the telson, the margin entire in *T. niceense*, excavated in *T. raschii*.

TRISCHIZOSTOMA RASCHII Esmark & Boeck, 1860. (Plate XVII. fig. 13; Pls. XVIII., XIX. figs. 2–11; Pls. XX., XXI. figs. 1–13, 15–18.)

Syn. 1860.	<i>Trischizostoma raschii</i>	Boeck (3).
1865.	"	Lilljeborg (5).
1870.	"	Boeck (7).
1872.	"	Boeck (8).
1886.	"	Bovallius (11).
1890.	"	Sars (13).
1893.	"	Della Valle (15).
1906.	"	<i>niceense</i> ♀ Stebbing (19).
1907.	"	<i>raschii</i> Stebbing (20).

The measurements quoted in the following description are taken from three specimens: an adult female from Norway, measuring 26 mm. from the tip of the rostrum to the tip of the telson; the immature specimen from the West of Ireland, 9 mm.; and a young one taken from the incubatory pouch of the first specimen, 7 mm. long. The female had seven young still remaining in the ovisac; the measurements of their appendages etc.

do not vary by the fraction of a millimetre. The intermedite specimen appears to be an immature female; no incubatory lamellæ are developed, but the proportions of the antennal joints agree with the adult form.

Head.—Much deeper than the peræon, as long as deep; rostrum horizontal, apically rounded. In the *adult* the head is slightly longer than the first segment of the peræon (3 mm. to 2.5 mm.); in the *immature* it is much longer; and in the *young* it is nearly twice as long (as 9 : 5). The huge *Eyes* cover nearly the whole surface of the head; they are composed of a great number of small, dark brown ommatidia, arranged in rows, with one row of unpigmented ommatidia following the contour of the pigmented mass and meeting in the medio-dorsal line. There are not less than 154 of the dark ommatidia, each side, but they are too closely crowded together to permit of ascertaining the exact number.

In the *immature* the eyes are reniform, almost but not quite touching dorsally, and not extending so far forward or downward as in the adult; not less than 120 pigmented ommatidia. In the *young* a large number of unpigmented ommatidia.

PERÆON.—The 1st segment of the peræon in the adult is the largest, the four following subequal, the 6th and 7th the smallest, all, except the first, produced at the posterior angle and rounded.

Side-plates.—*Adult* (see pereopoda figures). The 1st is very small, triangular, almost completely hidden by the 2nd, which is greatly dilated inferiorly, forming a large triangular lobe, reaching anteriorly to the infero-lateral margin of the head, and produced to a great length downward posteriorly, slightly emarginate behind. The 3rd is in shape obliquely oval, anterior margin convex, posterior emarginate, less than half as wide and slightly shorter than the 2nd. The 4th is shorter again, rounded anteriorly and deeply emarginate posteriorly, inferior margin truncate. The 5th is bilobed, posterior lobe deeper and wider than the anterior; 6th of similar construction, much smaller. The 7th is the smallest, wider than deep, with rounded corners. In the *immature* specimen the proportions of the peræon segments and side-plates are the same as in the adult.

In young. The first peræonal segment is the largest, all the others subequal; body deep; side-plates not so large in proportion as in adult, those of the second segment differing a little in shape.

PLEON.—*Adult* (Pl. XVIII. fig. 1). The first three segments large and subequal, the 1st pleon segment equalling the first peræonal segment in length (measured along the medio-dorsal line). Epimeral plates large and rounded; those of the 2nd segment with a diagonal carina terminating in a denticle at the postero-lateral angle, and those of the 3rd segment almost rectangular; 4th segment with a deep depression dorsally; 5th and 6th smaller, the 5th being slightly shorter than the 6th, which is emarginate dorsally, for the insertion of the telson.